Yanbu Industrial College

Department of Electrical Power Engineering Technology

EEET 103 Electrical Machines I

Lab Exercise No. 07

Title **EFFECT OF SPEED ON TERMINAL VOLTAGE OF SEPARATELY EXCITED DC GENERATOR**

Student Name: _____ **Student ID:** _____

Submission Date: _____ **Lab Section:** _____

Important Notes

1. Every student must write Name, Section, and Lab exercise No, Title, ID Number and Submission Date clearly in provided space.
2. Only neat, clean and hand written reports on this prescribed format given in E-learning will be accepted.
3. Students are encouraged to work and study together as team work is highly recommended.
4. No credit will be given for works that are copied from any source.
5. Assignments and reports must be turned in on time.
6. Please make photocopy of your lab report before submission as original may not be returned to you.
7. In case of late submission 20% of total credits will be reduced per day.

For Instructor's use only.	
Date Received	
Maximum Marks	**10**
Late By	**days**
Deductions	**%**
Marks Obtained	
Comments (If any)	

Signature: _____

EFFECT OF SPEED ON TERMINAL VOLTAGE OF SEPARATELY EXCITED DC GENERATOR

PERFORMANCE OBJECTIVES:

Upon completion of this laboratory experiment, the student will be able to:

- Describe the effect of operating a generator at less than rated speed.
- Explain the difference in speed-terminal voltage characteristics of separately excited shunt generator.

EQUIPMENT:

1. DM-100 DC Machine operating as a generator.
2. DYN-100 Dynamometer operating as a motor.
3. 0-125 volt Hampden variable DC power supply, 5 amps.
4. 0-150 volt Hampden variable DC power supply, 1 amp.
5. Two Hampden DC Voltmeters.
6. Two Hampden DC Ammeters.
7. Tachometer.

DISCUSSION:

If the field strength is constant, the output voltage goes up in direct proportion to the increase in speed. Permanent magnet DC generators, like you find in tachometers have constant field strength. So do separately-excited DC generators, if the field current is not changed. However, in the self-excited DC generator, there is some change in field current and is dependent on generated voltage, and that changes with speed.

Assume you have a DC generator that produces rated voltage, say, 125 volts at rated speed, say 1800 rpm. That means at 1800 rpm, the armature is generating the right amount of voltage to produce the amount of field current to generate 125 volts. At any speed lower than 1800, the armature will produce less than 125 volts. The exact amount depends on two things; first the slow speed will result in a smaller output simply because generated voltage is proportional to speed. But this smaller output also results in a smaller field current which means a weaker magnetic field. This has the result in lowering the output voltage a little more, until the generator reaches a new balance point, where for the speed, the field current supports the right field for that voltage. This effect is more pronounced at the slower speeds. The closer the generator gets to rated speed, the closer it gets to rated voltage.

CAUTION!

1. **High voltages are present in this experiment. Do not make any connections while the Power is on.**
2. **The power should be turned off immediately after completing measurement.**
3. **All the readings must be taken as quick as possible.**

CIRCUIT CONNECTIONS (SEPARATELY EXCITED DC GENERATOR)

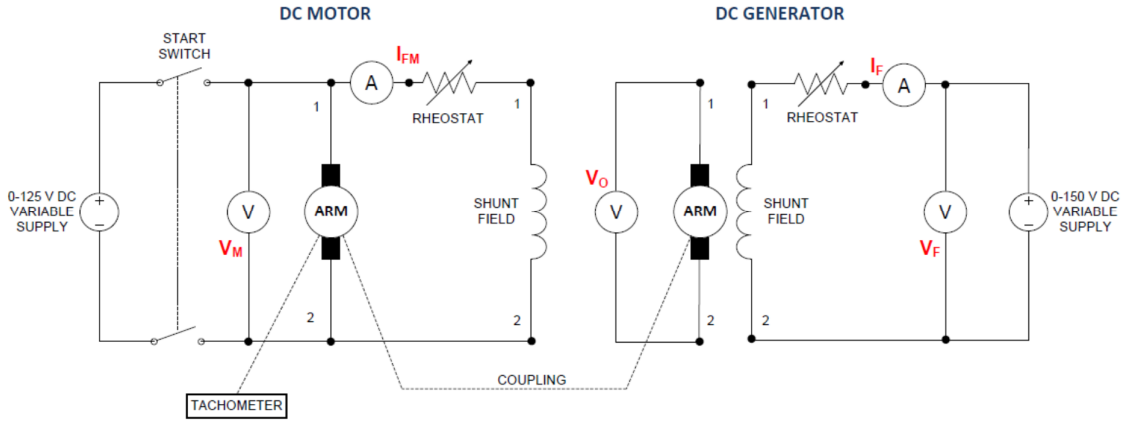


Figure 1.1

PROCEDURE:

1 Place the two machines on the bedplate with the motor on the left and the generator on the right.

2 Couple the machines tightly using the coupling. Be sure the coupling fits snugly inside both shafts.

3 Clamp the machines tightly to the bedplate.

4 Make the motor connections shown in Fig. 1.1 but do not turn the power ON yet. Turn the knob of the 0-125 variable DC supply fully counterclockwise to its zero position. Turn the motor's field rheostat knob fully counterclockwise to its minimum resistance position.

5 Make the generator connections shown in Fig. 1.1 but do not turn the power ON yet. Turn the generator's field rheostat knob fully counterclockwise to its maximum resistance position. Turn the knob of the 0-150 volt supply fully counterclockwise to its zero position.

6 Have the teacher check your connections to be sure they are correct.

7 Turn ON the main AC circuit breaker; turn ON the 0-125 volt DC supply circuit breaker; and turn ON the circuit breaker switch that starts the motor.

8 Slowly turn the knob of the 125 volt supply fully clockwise to its maximum output position. The motor should now be running. With the tachometer directed at the motor shaft, turn the motor's field rheostat knob clockwise until the motor is rotating at 1800 rpm.

9 Slowly increase the output of the 0-150 volt DC supply to 125 volts.

10 Connect the voltmeter to the armature of the generator and slowly turn the generator's field rheostat knob counter-clockwise until the generator output reads 115 volt.

11 It may be necessary to make fine adjustments of both the generator's and motor's field rheostat knobs to obtain exactly 115 volts at exactly 1800 rpm. Record in observations Table 1 the speed and terminal voltage.

12 While holding the tachometer on the shaft of the motor (or generator) slowly turn the knob of the 0-125 volt DC supply counterclockwise, until the motor is rotating approximately 1600 rpm. Record in observations Table 1 the speed and terminal voltage.

13 Repeat steps 12 for approximate speeds of 1400, 1200, 1000, 800 and 600 rpm.

14 Turn OFF all circuit breaker switches. Disconnect all leads.

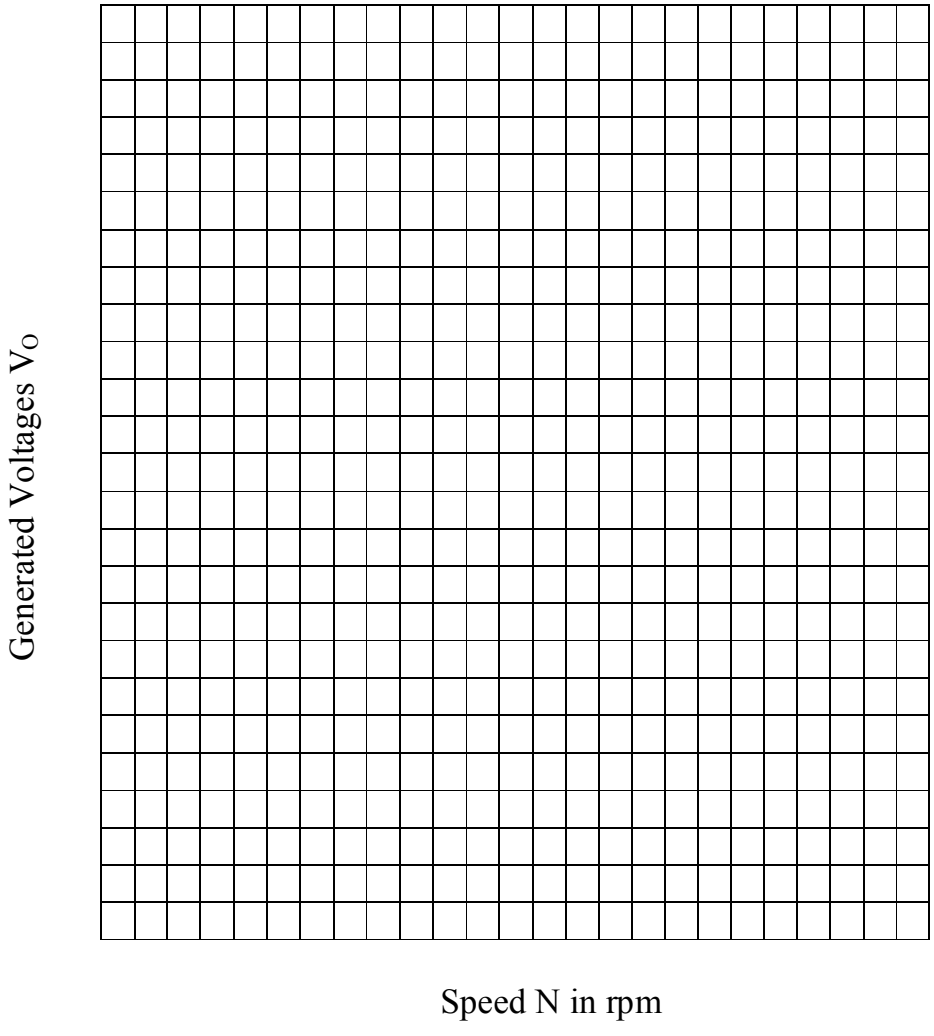
OBSERVATIONS:

Speed of Generator N in rpm	**1800**	**1600**	**1400**	**1200**	**1000**	**800**	**600**
Shunt field current I_F in Amp (Constant)							
Open Circuit Voltage V_0 in Volt							

Table 1

GRAPH:

Plot a graph of the output voltage V_0 for various values of speed N from the readings in observations Table 1.



REVIEW QUESTIONS

1. Generator output voltage is directly proportional to:

	a	Armature current and voltage.
	b	Speed and field strength.
	c	Speed and armature voltage.

2. A separately excited generator has a:

	a	Constant field strength.
	b	Changing field strength.
	c	Zero field strength.

3. If the field strength doesn't change in a separately excited generator, output voltage is:

	a	Directly proportional to armature voltage.
	b	Directly proportional to armature current.
	c	Directly proportional to speed.

4. Usually, when the output voltage of a generator is specified, it is specified at a certain speed. Explain why?

5. For separately-excited generator, did equal changes in speed result in equal or unequal changes in output voltage? Explain if this was expected and why?

FINAL CHECKLIST

All the students must make sure, before they leave the Lab:

1. Turn the value of variable power supplies and resistive load to zero
2. Main power switch on the work bench is put "OFF".
3. All the connection of machines/ equipment is removed.
4. All machines/meters are properly placed (slide in) either in storage cabinet or in work station itself.
5. All connecting leads are sorted out according to their length and colours and placed on the hooks provided in the side of the work station.
6. Submit your answers to the questions, together with your data, calculations (if any) and results before the next laboratory sessions.